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Extruded Objects and Method for Manufacturing the Same

The invention relates, in general, to the use of valueless waste materials, such as wood chips, sawdust, bamboo chips, waste paper, sugar cane bagasse, crushed grain, husks, coffee waste, straw or chaff from wheat, barley or rice plants or other grain types, rinds, textile remnants or rags, asbestos, glass fibers, leather remnants, etc. and, in particular, to extruded objects for various applications in the form, for example, of tubes, rods, plates, slabs, disks, blocks, etc. and a method for manufacturing the same, wherein such objects are shaped from one or more of said valueless waste materials mixed with one or more suitable synthetic resins by means of an extrusion apparatus, the cylinder of which is kept heated such that said synthetic resin or resins can be melted therein to the desired degree.

It is known to manufacture various types of objects by extrusion, for example, tubes, plates, slabs, disks, rods, blocks, etc. from metals, plastics, fibrous materials and the like.

Cited as a typical example of the aforementioned extruded objects are relatively thick conventional type tubes and a description is given below for the manufacturing methods thereof:

(1) Tubes made of synthetic resins are manufactured by means of extruding machines or injection molding machines;

(2) Metal tubes are manufactured by means of cold-drawing, hot-drawing or welding processes;

(3) Paper tubes are manufactured by spiral or lateral winding of paper strips.

However, most of the conventional tubes manufactured by means of the aforementioned processes have the following drawbacks:

(1) Conventional tubes made of synthetic resin have the drawback that they are not always adequately resistant to compression and shock. To eliminate this drawback, glass fibers must be added as a reinforcing agent although this causes an unavoidable increase in the production costs.

(2) The manufacture of metal tubes requires extensive equipment and a large number of devices. These metal tubes are not only subject to strains caused by rust or other stresses but also exhibit little resistance to impact loads.

(3) Paper tubes have the drawback that they are not only weak with respect to compression and bending loads but are also weakened by the influence of moisture. Furthermore, they are easily discolored on their surface and, once discoloration has occurred, the stains cannot be easily removed. Furthermore, it is generally known that this manufacturing method tends to produce many non-conforming products.

It is evident that other products in the form of rods, square rods, angle pieces, blocks, slabs, plates, disks, etc. show defects that are identical or similar to those described with respect to tubular products.

Thus, it is the object of the invention to provide a new use or application for valueless waste materials, such as wood chips, sawdust, bamboo chips, waste paper, crushed grains, husks, bagasse, coffee waste, straw or chaff from wheat, barley, rice and other types of grain, rinds, textile remnants, such as rags, asbestos, glass fibers, leather remnants and the like.

It is a further object of the invention to provide novel shaped products which are strong, moisture proof and corrosion proof and which can be manufactured at very low cost. Another object of the invention is to provide a novel material to form various types of tubes, rods, slabs, plates, disks, blocks, etc. with excellent properties. A further object of the invention is to provide a novel and

suitable method for manufacturing the desired shaped objects with excellent properties by means of few installations and little equipment.

These and further objects and advantages of the invention will become evident from the following description in which reference is made to several preferred embodiments of the invention which are shown in the drawing by way of example.

Fig. 1 is an elevation of a tubular object according to the invention with a cutaway portion.

Fig. 2 is a partial perspective view of a rod-shaped object according to the invention.

Fig. 3 is a perspective view similar to that shown in Fig. 2 and 3 of a square shaped object according to the invention.

Fig. 4 is a perspective view similar to that shown in Fig. 2 and 3 of a slab shaped object according to the invention.

Fig. 5 is an enlarged, partial view of the exact structure of the shaped objects shown in Fig. 1 through 4.

Fig. 6 is a sectional elevation of a preferred embodiment of the extrusion apparatus for shaping the objects, particularly for shaping tubular objects according to the invention.

As shown in Fig. 6, mixture 21 comprising one or more valueless waste materials, for example, wood chips, sawdust, bamboo chips, waste paper, bagasse, crushed grains, husks, coffee wastes, straw or chaff from wheat, barley, rice plants or other grain types, rinds, textile remnants or rags, asbestos, glass fibers, leather remnants, etc. and one or more synthetic materials, such as acrylonitrile butadiene styrene resins, acrylonitrile styrene resins, styrene resins, nylon resins (polyamide resins), vinyl chloride resins, vinyl acetate resins, acrylic resins, melamine resins, polyester resins, etc. is introduced through a feed hopper 22 into the extruding apparatus which is generally identified by the reference number 20. The selection of one or more of these valueless waste materials may be based on which one or which ones are most readily and immediately available. For the selection of the synthetic resins it is important to select one or more with suitable properties for the intended application.

When the mixture is produced, the proportion of valueless materials or waste materials which serve as structural or skeletal elements is preferably in the range of 90 to 50% by volume while the

corresponding proportion of synthetic resin materials which act as binders ranges from 10 to 50% by volume. In this connection, it is preferred to break or crush the structural or skeletal elements into small pieces such that the average grain size will fit through a sieve with a mesh size of no more than 4 mm (5 mesh) and to dry them in order to reduce their water content to less than 10% by weight. However, the permissible range of their water content can vary as a function of the forming temperatures and it should be noted that the permissible limit of their water content should be all the smaller, the higher the forming temperature to prevent the occurrence of undesirable cracks during the extrusion process. However, if a suitable suction device is provided, the permissible limit of their water content may fall within a wider range of up to a maximum of 15%.

While mixture 21 is filled into cylinder 24 of extrusion apparatus 20, it is so thoroughly mixed and compressed by a screw element 23 that a significant amount of both friction heat and compression heat is generated. These heat quantities in turn support the intimate miscibility of the structural or skeletal elements and the synthetic resin acting as binder. Particularly if suitable fibrous materials are used as skeletal elements, the fibers contained therein are interwoven and combined in a complex manner which makes it possible to produce particularly preferred products with increased structural stability. Thus, it is obvious that the use or addition of mineral components, such as asbestos, as skeletal elements improve rigidity.

A plurality of suitable heating devices 25, such as gas or electrical heaters, are provided adjacent the outer circumference of cylinder 24, to keep cylinder 24 at the desired temperature.

The temperature within cylinder 24 must be determined so that it corresponds with the properties or special characteristics of the synthetic resin or resins employed as well as with those of the skeletal or structural elements. This means that the maximum temperature may not exceed the value at which the structural elements may decompose and generate gaseous substances as a result of such decomposition, while the minimum temperature may not be lower than the value which permits the synthetic resins to melt such that the resins can penetrate among the granules of the skeletal elements which are thus embedded therein so that a structure is obtained as that shown in Fig. 2.

Tests have shown that with the use of a mixture comprising wood chips as the skeletal elements and vinyl chloride as the binder, the most suitable temperature is approximately 120° C, and with the simultaneous use of wood chips, rinds and waste paper as skeletal elements and only acrylonitrile butadiene styrene resin as binder, the most suitable temperature is in the proximity of 250° C. Furthermore, it was determined that with the use of a mixture comprising asbestos and glass fibers as skeletal elements and nylon resin (polyamide resin) as binding agent, the most suitable temperature is approximately 300° C.

As shown in Fig. 6, an outer form or die 30 and an inner form or die 31 are arranged and supported on the outer end of cylinder 24 by means of a suitable die holding device 32. The inner die 31 as well as the outer die 30 are fixed or mounted in cylinder 24 so that they can be replaced as a function of the desired shape of the materials to be extruded.

It is evident that the temperature within cylinder 24, the effective length and the effective diameter of such cylinder and the revolutions per minute of the screw element 23, the gap of the screw and the compression capacity of the extrusion apparatus are interdependent and that they should be determined relative to the properties of the skeletal elements or components to be used while taking into account the viscosity of the molten resins employed. Through tests it was determined that the preferred compression capacity should range from 3/4 to 1/4.

As shown in Fig. 6, material 21 which was previously mixed and compressed in the described manner is extruded through dies 30 and 31 onto a suitable receiving support 50, whereby it takes on the shape of a tubular product, and is cooled to a solid state by means of suitable water cooling devices 40 or air cooling devices (not shown). The only subsequent steps required are cutting and finishing.

Other shaped products, for example in the form of rods, angle pieces, square rods, blocks, slabs, plates, disks, etc. may be produced in like or similar manner by simply mounting a different die or dies designed to provide the appropriate shape.

The invention makes it possible to provide novel extruded products made of an intimate mixture comprising one or more skeletal elements embedded in a binder of a resin type element or elements;

such products have wet strength and are not subject to discoloration, they are highly resistant to compression, tension, bending and impact loads as well as to corrosion and may advantageously be produced in large quantities using little equipment and inexpensive materials.

The products manufactured according to the invention are suitable for a wide variety of applications, for example, building materials or various types of bobbins and cores for winding various types of foil materials. Particularly for temporary use, the products according to the invention have special advantages due to their low production costs. A further advantage of the invention consists in the recycling of waste materials, which more or less facilitates the disposal of such materials and saves the corresponding disposal costs.

Furthermore, the invention relates to molding compounds based on a mixture of two different types of materials, with one type of material consisting of one or more valueless waste materials, such as wood chips, sawdust, bamboo chips, waste paper, bagasse, crushed grains, husks, coffee wastes, straw or chaff from wheat, barley, rice or other grain types, rinds, textile remnants or rags, asbestos, glass fibers, leather remnants, etc. which serve as structural or skeletal elements and the other type of material comprising one or more synthetic resins, such as acrylonitrile butadiene styrene resins, acrylonitrile styrene resins, styrene resins, nylon resins, vinyl chloride resins, vinyl acetate resins, acrylic resins, melamine resins, polyester resins, etc. which act as binding elements, whereby the two materials may be thoroughly mixed and compressed in a hot process and extruded by means of suitable forming equipment to obtain the desired shape.

Claims

1. Extruded products which are converted into the desired shape by conventional extrusion apparatuses, characterized in that the products are made of a mixture comprising at least two different types of material, wherein one type of material comprises one or more valueless waste materials, particularly wood chips, saw dust, bamboo chips, waste paper, bagasse, crushed grains, husks, coffee wastes, straw or chaff from wheat, barley, rice or other grain types, rinds, textile remnants, asbestos, glass fibers, leather remnants, etc. which serve as structural or skeletal elements and the other type of material comprises one or more synthetic resin(s), particularly acrylonitrile butadiene styrene resins, acrylonitrile styrene resins, styrene resins, nylon resins, vinyl chloride resins, vinyl acetate resins, acrylic resins, melamine resins, polyester resins, etc. which serve as binding elements and wherein the two types of materials are thoroughly mixed and compressed by means of a hot process and extruded by means of suitable forming equipment into the desired form, particularly tubes, rods, angle pieces, square rods, blocks, slabs, plates or disks.

2. Method for manufacturing extruded products for various applications, characterized in that a mixture of structural or skeletal elements is produced comprising one or more valueless waste materials, particularly wood chips, saw dust, bamboo chips, waste paper, bagasse, crushed grains, husks, coffee wastes, straw or chaff from wheat, barley, rice or other grain types, rinds, textile remnants, asbestos, glass fibers, leather remnants, etc. and that such mixture is broken or crushed into small pieces with an average grain size that fits through a sieve with a mesh size of no more than 4 mm (5 mesh) and that it is dried in order to reduce its water content to less than 15% by weight, that binding elements in the form of one or more synthetic resins, particularly acrylonitrile butadiene styrene resins, acrylonitrile styrene resins, styrene resins, nylon resins, polyester resins, vinyl chloride resins, vinyl acetate resins, acrylic resins, melamine resins, etc. are produced and reduced to small pieces or powders, that the structural element or skeletal material is mixed with the material of the binding element at a ratio v of approximately 9 : 1 to 5 : 5 with respect to volume and that this mixture is compressed in a hot process until the initial volume is reduced by approximately 3/4 to 1/4 and the mixture is extruded through suitable shaping equipment which is designed to produce the desired shape and is fixed or mounted on a conventional extruding apparatus for producing shaped products.